CANOTIA

Volume 2, issue 3

Contents

September 2006
Vascular Plant Herbarium

School of Life Sciences, Arizona State University

CANOTIA

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Canotia publishes botanical and mycological papers related to Arizona. These may include contributions to the Vascular Plants of Arizona project, checklists, local floras, new records for Arizona and ecological studies. All manuscripts are peer-reviewed by specialists. Acceptance for publication will be at the discretion of the editor. At least 30 printed copies of each issue are distributed to libraries in the United States, Europe, and Latin America. Anyone may download copies free of charge at http://lifesciences.asu.edu/herbarium/canotia.html.

Canotia is named for *Canotia holacantha* Torr. (Celastraceae), a spiny shrub or small tree nearly endemic to Arizona.

NOTEWORTHY DISTRIBUTIONS AND ADDITIONS IN SOUTHWESTERN CONVOLVULACEAE

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ABSTRACT

Since 1998 when the Convolvulaceae was published for the Vascular Plants of Arizona, *Calystegia sepium* ssp. *angulata* Brummitt and *Convolvulus simuans* L. M. Perry have been added to the flora and another species, *Jacquemontia agrestis* (Choisy) Meisner, has been located that had not been found since 1945. Descriptions, keys, and discussions of these are given to place them in the flora. Additionally, these and *Dichondra argentea* Willdenow, *D. brachypoda* Wooton & Standley, *D. sericea* Swartz, *Ipomoea aristolochiifolia* (Kunth) G. Don, *I. cardiophylla* A. Gray, *I.* ×*leucantha* Jacquin, and *I. thurberi* A. Gray, with new noteworthy distributions records in the region, are discussed and mapped. All taxa documented by recent collections are illustrated to facilitate identification.

DISTRIBUTION PATTERNS AND ADDITIONS TO THE ARIZONA FLORA

Three notable disjunct records have been discovered within Arizona since the treatment of the Convolvulaceae was published for the state (Austin 1998a), *Calystegia sepium* ssp. *angulata* Brummitt, *Convolvulus simulans* L.M. Perry and *Jacquemontia agrestis* (Choisy) Meisner. Additionally, *Ipomoea aristolochiifolia* (Kunth) G. Don has been found just south of the border in Mexico. All of these are significant disjunctions in the family, but there are others that have been documented for years and little discussed. Although these are not the only disjunctions within the Convolvulaceae in the region, they are representative of floristic patterns in this and other families. The following discussion updates the known status of the Convolvulaceae in Arizona and compares several species to the floras from which they were derived. Photographs are also presented to help with identification (Figs. 5-14).

Distribution patterns within the family fall within three primary types. Those patterns are species derived from the Californian, Great Plains, and tropical floras.

1). **Californian Flora**. Takhtajan (1986) among others has discussed the flora of the Californian Province.

CONVOLVULUS. *Convolvulus simulans* was not known in Arizona until 1991 when it was found by Marc A. Baker (*Baker 8170*, ASU, ARIZ) in Salt Gulch (Gila Co.), but it was not correctly identified until much later. Baker collected it again in 2004 (*Baker 15687*, ASU, ARIZ) and Elizabeth Makings found it in a nearby

locality in 2005 (*Makings 2013*, ASU, ARIZ). Finally a specimen was identified by David Keil and he informed the curators of ASU and ARIZ.

These annual herbs are disjunct from the western slopes of California between western Riverside and San Diego Counties (Anonymous 2005, Austin, in prep.) to Gila County in Arizona (Fig. 1). This disjunction of several hundred miles probably has resulted from the reduction of a wider distribution due to climatic changes. Other well known relict species in both states include *Fremontodendron californicum* (Torr.) Coville, *Quercus turbinella* Greene, *Rhus aromatica* Aiton, and *Vauquelinia californica* (Torr.) Sargent (Rondeau et al. 1996). A lesser known example is *Pholistoma racemosum* (Nutt.) Constance that has a distribution more like that of *Convolvulus*.

For the moment, this species is retained in *Convolvulus*. These plants do not conform in all respects to the morphological traits that have been listed, for example, by Ooststroom (1939), O'Donell (1959), Sebsebe (1998), and Johnson (2001). After their original description, Hallier (1893) pointed out morphological differences between *Convolvulus* and *Calystegia*, and subsequently Lewis and Oliver (1965) and Brummitt (1965, 1974, 1980) influenced others to recognize both as distinct genera. Recent phylogenetic analysis based on molecular genetics suggests that those two may be part of a single lineage in spite of their divergent morphology (Miller et al. 2002, Stefanovic et al. 2002, Stefanovic et al. 2003).

A key to the species and photographs (Fig. 6) of *Convolvulus* in Arizona, and a description of *C. simulans* are given here.

1. Leaf bases cordate to truncate, hastate or sagittate; plants perennial; corollas 1.2-3 cm. long.

2. Leaf blade almost as broad as long; calyx 3-5 mm long; perennial from deep, creeping stems, forming large patches ..... ***C. arvensis***
2' Leaf blade usually much longer than broad; calyx 6-12 mm long; perennials from taproot, sometimes divided at apex, but not forming large patches ..... ***C. equitans***

1' Leaf bases cuneate; plants annual; corollas 4-6 mm. long ..... ***C. simulans***

Convolvulus simulans L.M. Perry (L. v. to make like, resembling). Small-flowered morning glory. -- HERBS, annual, the stems diffuse, 1-3 dm long, erect to ascending, 1-2 mm in diameter, minutely puberulent to pubescent. LEAVES with blades oblong to linear-lanceolate, 1.5-4 cm long, basally cuneate and narrowing to a somewhat winged petiole shorter than blade, the margins entire. INFLORESCENCES 1-flowered, puberulent; bracts spathulate to subulate, placed 4-5 mm below the calyx, 3-8 mm long. FLOWERS on peduncles 1-3 cm long; sepals oblong-ovate, 3-4 mm long, apically obtuse, pubescent, the margins scarious; corollas white-tinged or striped with blue or pink, 4-6 mm long, 5-lobed for 1/3-1/2 their length, glabrous. FRUITS globose, 5-8 mm wide, glabrous; seeds 1-4, brown, 2 mm long, minutely

papillate. [*Breweria minima* A. Gray, non *Convolvulus minimus* Aublet; *Convolvulus pentapetaloides* auct., non L.]. --Grassy and rocky places, friable wet clay soils, serpentine ridges; Gila Co. (Tonto Basin); 0-730 m (0-2400 ft.); Mar-May; sw CA; n Baja C., s to 30°42' (El Rosario, Wiggins 1980).

This rare species is declining in North America due to habitat loss (Reiser 1994). Populations are often small, and may be near vernal pools in California. The species was illustrated in the flora of Baja California (Wiggins, 1980, p. 375, fig. 337).

Unlike all other family members in Arizona, these are spring flowering. All of the others either blossom in the summer or in the fall. Some of the associated species are *Amsinckia menziesii* (Lehmann) A. Nelson & J.F. Macbride, *Chamaesyce albomarginata* (Torr. & A. Gray) Small, *Cryptantha barbigera* (A. Gray) Greene, *Eriogonum inflatum* Torr. & Frém., *Erodium texanum* A. Gray, *Harpagonella palmeri* A Gray, *Heliomeris longifolia* B.L. Robinson, *Lycium pallidum* Miers, *Prosopis velutina* Wooton, *Simmondsia chinensis* (Link) C.K. Schneider, and *Ziziphus obtusifolius* (Hooker ex Torr. & A. Gray) A. Gray.

2). **Great Plains Flora**. Although *Calystegia* is a pan-temperate genus, one species is clearly allied with the Great Plains Flora, *C. macounii* (Greene) Brummitt. The related *C. sepium* (L.) R. Br. has a number of infraspecific taxa, and the one in the southwestern states is not obviously part of the grasslands flora. Instead, *C. sepium* ssp. *angulata* Brummitt is spread across North America in mostly higher latitudes. For convenience, it is mapped and discussed with *C. macounii*.

CALYSTEGIA. The misunderstanding of taxa within *Calystegia* has confounded other aspects of its biology for decades. Although Tryon (1939) tried to resolve some of the difficulties in what is now *Calystegia*, it was not until Brummitt (1965, 1980) examined them that the species limits became clarified. One Great Plains taxon that most have submerged within the variable *C. sepium* is *C. macounii* (cf. Austin 1986, 1998a, Austin et al. 1998). This species was collected in northern Arizona on 17 June 1887 (Yavapai Co., *Mearns 158*, NY) and in San Miguel Co., New Mexico on 14 June 1927 (*Bro. Arsene 18720*, US), but both those and later specimens were misidentified as *C. sepium* until Austin (1990a, 1991, 1992) studied them. Occurrence of this species represents a substantial western extension from the main range of the species (Fig. 1).

It is not clear how *C. macounii* became established in these western areas. Several of the sites where the plants were known historically and where they were studied in the field in Arizona in 1990 (*Austin and Austin 7661*, ASU) are near old logging areas. Railroad extensions came from the northeast into these areas and timber and other materials were transported in both directions. Possibly the plants were accidentally introduced during that period. However, it seems equally likely that the species is a native part of the flora. There are many known species in several families that are disjunct as remnants in pockets of Great Plains vegetation throughout

both states. Examples of those disjuncts include *Buchloe dactyloides* (Nutt.) Engelman, *Ipomoea leptophylla* Torr. in Frém., and *Penstemon ambiguus* Torr.

It may simply be that the species is uncommon throughout its range and that it exists in small metapopulations, especially outside the central Great Plains region. For example, *C. macounii* was recorded in Wyoming in the Flora of the Great Plains (Austin 1986) based on a specimen collected in the 1890s in Niobara County, but was excluded from the state flora by Dorn (1992). That prompted Walter Fertig to search for the plants. He and Laura Welp found them, in Laramie County (Fertig 2001).

Two *Calystegia* taxa are known from New Mexico and Texas, *C. sepium* ssp. *angulata* and *C. silvatica* ssp. *fraterniflora* (Mackenzie & Bush) Brummitt. The second taxon occurs west to Texas, although there are old collections from Grant County, New Mexico (e.g., *Wooton s.n.* 19 July 1902, *Wooton s.n.* 6 August 1907, both ARIZ). Since *C. silvatica* has not been relocated in New Mexico, these were presumably adventive and did not persist.

Study of the Convolulaceae of New Mexico (Austin 1990a) indicates that *C. sepium* is part of the flora of that state, being known from at least the counties of Colfax (*Clark 16131*, UNM), Dona Ana (*Wooton 3353*, ARIZ), Rio Arriva (*Newberry s.n.* US), San Juan (*Standley 7031*, US), San Miguel (*Vasey s.n.*, NY), and Taos (Fig. 5). Austin et al. (1998) discussed the species in Texas and cited specimens that had been misidentified by Correll and Johnston (1970) and others. Similarly, the species is recorded in Colorado, Idaho, and Utah, and ranges north to Washington and Oregon, and east to South Carolina (Austin in press, Brummitt 1980, Welsh et al. 1987, 2003).

Calystegia sepium (L.) R. Br. ssp. *sepium* has never been documented in either Arizona or nearby states. Although *C. sepium* ssp. *angulata* was listed by Heil and Kane (2003) from Apache and Navajo Counties in Arizona, until recently Austin (in press) had seen modern collections from only Colorado and New Mexico. Apparently the 2003 report was based on misidentified specimens of *C. macounii* (Apache County, *Parker 8332*, *Halse 485*, both ARIZ; Navajo Co., *Harrison 5506,* ARIZ).

Calystegia sepium was excluded from the Arizona flora by Austin (1998a) because the only voucher was a specimen collected in the Huachuca Mountains in 1882 (*J.G. Lemmon 2832*, GH). No one had found it in the state since (Austin 1991, 1998a). Then in August of 2005 a specimen was collected reconfirming that *C. sepium* ssp. *angulata* does occur in Arizona. Elizabeth Makings found the species growing along the San Pedro Riparian National Conservation Area. This locality is in the St. David Ciénega southeast of Benson (31°50.561'N, 110°13.62'W). Thus, after a hiatus of 123 years, the species was relocated in the state (Fig. 1).

There seem to be two possible reasons for the long "disappearance" of the subspecies in Arizona. 1) *Calystegia sepium* ssp. *angulata* is not part of the flora, but

is irregularly and erratically introduced. Why it seems to disappear once introduced is not clear. 2) Alternately, the local growing conditions may be such that, once established, they do not sprout and reappear regularly. *Calystegia sepium* ssp. *angulata* is apparently like the other infraspecific taxa in the species in that it requires high moisture to thrive. The plants that Makings found were growing with *Carex praegracilis* W. Boott, *Cephalanthus occidentalis* L., *Lythrum californicum* Torr. & A. Gray, *Salix* sp., *Schoenoplectus americanus* (Pers.) Volkart ex Schinz & R. Keller, *Typha domingensis* Pers., and other wetland species.

If the second alternative is correct, the conditions for the subspecies to grow may have been dramatically altered by the 3 May 1887 earthquake, or even those subsequent to it (Fellows 2000). It is known that the 1887 earthquake drastically changed the water table such that springs in the Sulphur Springs Valley dried up (O'Hare 1998). Less well known is that more than 20 earthquakes with magnitudes of greater than 5.0 have occurred in or near Arizona since 1850 (Fellows 2000). Because of earthquakes and heavy urban consumption, water tables in Arizona are now more than 200 feet below the levels they stood just a century ago (Matlock & Davis 1972, Laney 1998). Perhaps *C. sepium* ssp. *angulata* was more common before the dramatic changes in the water table. It is still possible that the subspecies will yet be found in the northeastern part of Arizona because it grows in the San Juan region of Colorado and New Mexico (Figs. 1, 5).

Due to this addition to the flora, a key to the three taxa and a description of *C. sepium* ssp. *angulata* is included.

1. Leaves linear to lanceolate-hastate, the upper-most gradually reduced to bracts; bracts separate and not enclosing the calyx ..... ***C. longipes***
1' Leaves ovate to ovate-lanceolate, often hastate, similar in shape and size throughout; bracts enveloping and obscuring the calyx.

2. Blade of leaf basally rounded; plants normally pubescent on all vegetative parts ..... ***C. macounii***
2' Blade of leaf basally cordate-sagittate to hastate; plants normally glabrous or with a few trichomes on petioles ..... ***C. sepium* ssp. *angulata***

Calystegia sepium (L.) R. Br. **ssp. *angulata*** Brummitt (L. n. *saepes*: a hedge; L. adj. *angulatus*: angular, referring to the basal angles of the leaves). Hedge Bindweed – HERBS with rhizomatous, twining stems, angular in cross-section, glabrous. LEAVES ovate to ovate-lanceolate, glabrous, 2-15 cm long, 1-9 cm wide, basally cordate-sagittate to hastate, 5-nerved, the auricles obtuse to acute or 2-3 dentate, rarely 2-lobed, apically acute to acuminate, the border entire or undulate; petioles 2-7 cm long. INFLORESCENCES of solitary flowers, on peduncles 3-13 cm long; bracts surrounding calyx angular-sulcate, ovate, convex, glabrous or ciliate, foliacous, the borders at times pinkish, 14-26 mm long, 10-18 mm wide, mucronate, mostly acute, the pedicels absent. FLOWERS: sepals elliptic to ovate-lanceolate, subequal, 11-15 mm long, 4-6 mm wide, thin, transparent, acute to almost obtuse, mucronate, apically ciliate; corollas funnelform, white or tinged on limb with rose or

pink, 4.5-5.8 cm long; stamens 23-29 mm long, almost equal, basally glandular pubescent; style 20-23 mm long. FRUITS capsular, 10-13 mm in diameter, ovoid, accompanied and partly surrounded by the enlarged bracts, which reach 30-35 mm long. SEEDS 4.5-5 mm long, black, glabrous, smooth or granulose. [*C. sepium* var. *angulata* (Brummitt) N. Holmgren]. Moist habitats, near streams, elsewhere in thickets and fence rows: Cochise Co.; 1127 m. (3700 ft.); Jun-Aug; MA to WA, NC to AZ. As pointed out by Holmgren (1984) for the west, the subspecies is uncommon throughout its range.

Through much of its range, this species may be confused with *C. silvatica* (Kitaibel) Grisebach. Living plants are easily separated. *Calystegia silvatica* has saccate calices, whereas *C. sepium* has calices that are more tightly appressed. Leaves are, however, the best way to distinguish the two species. *Calystegia sepium* and *C. macounii* have a clear V- or U-shape to the base of the leaf blade where the petiole attaches and in *C. silvatica* the blade base is quadrate. These differences are harder to see in pressed material, but can be detected with a little practice. Overall, leaf shape and pubescence are perhaps the easiest way to separate *C. sepium* from other species in the genus.

3). **Tropical Flora.** There are two tropical sources for plants in the region, the Chihuahuan Desert and the Sonoran Desert. Because of elevation, climate, and other distinctions, the floras of those two biotic areas tend to be distinctive (McLaughlin 1986, 1989, 1992).

DICHONDRA. The three species of *Dichondra* in the southwestern United States are on the northern end of tropical distributions. Both *D. argentea* Willdenow and *D. brachypoda* Wooton & Standley are derived from the Chihuahuan floristic region, while *D. sericea* Swartz is allied with the Sonoran flora. *Dichondra micrantha* Urban occurs in lawns, but is not a native of the area, having been introduced for cultivation (Austin 1998b). The three of four Arizona species are illustrated here (Fig. 8).

Dichondra argentea (Fig. 2) has not been found in Arizona since 30 September 1931 (*Harrison 8256*, ARIZ) when it was discovered in the vicinity of the Bisbee mines. Austin (1991, 1992, 1998a) speculated that the species had been extirpated from Arizona. No modern collections have been located.

The species with the most well-known populations along the border with Mexico is *D. brachypoda*. These small herbs are located in moist canyon pockets in several mountain ranges along southeastern Arizona, southern New Mexico, and in one range in southwestern Texas (Fig 2). This distribution is not the long disjunct type of some other species in the region, but each mountain group has pockets of these plants that are separated within and between ranges.

Dichondra sericea has been collected repeatedly in the same location in Santa Cruz County near the Mexican border since 1936 (cf. Toolin et al. 1980, Austin 1991,

1992, 1998a). No one has found other populations in the period since, although occasionally specimens of *D. brachypoda* are misidentified as this species. While the leaves of *D. brachypoda* may appear "discolorous" because of a difference in the tissues in the upper and lower surfaces, the young leaves are almost the same color. If there is doubt, the youngest leaves on specimens must be examined. It is a dense pubescence that makes the leaf surfaces different colors.

The closest population of *Dichondra sericea* to Arizona has been found is in the Río Mayo region of southern Sonora and Chihuahua (Austin in Martin et al. 1998). From there it is fairly common in moist sites from Baja California across to Tamaulipas and south (Fig. 2).

IPOMOEA. Three species of *Ipomoea* are mapped that fall within this tropical pattern (Figs. 3). Differences are notable among those species. The most recently discovered will be discussed first and followed by comments on others.

Tom Van Devender and Ana Lilia Reina G. collected *Ipomoea aristolochiifolia* (Kunth) G. Don near Agua Prieta in 2005 (*2005-1627*, *2005-1638*, ARIZ, MEXU, USON). This is the Mexican town that lies about 10 miles south of Douglas along the southeastern Arizona border (Fig. 3). The closest known locality for that tropical morning glory is in the Municipio de San Javier in south-central Sonora. The species is more common farther south in Mexico, also having been recorded from Baja California Sur, Sinaloa, Jalisco, Guerrero, Edo. México, Michoacán, Morelos, Oaxaca, and Veracruz. It also occurs through Mesoamerica and into Colombia, Venezuela, Ecuador, Peru, Bolivia, and Brasil.

The pattern of the range of this species suggests that it may simply have been a part of the border flora all along, but Van Devender and Reina are dubious. Both samples were from cattle pastures where there has been ample exchange of materials from farther south. It seems equally possible that the species may have been introduced with cattle from the tropical parts of its range. The notable gap in northeastern Sonora (Fig. 3) may resolve part of the problem when that area has been more thoroughly collected. Arroyo Agua Prieta is a northwestern tributary of the Río Bavispe (=Yaqui), and that north-south river valley serves as a natural corridor for dispersal.

Ipomoea cardiophylla A. Gray was first found in the Mule Mountains by Goodding (*206-61*, ARIZ) in September of 1961. Later, it was found outside Tombstone (*Walker s.n.*, ARIZ) in September of 1975. However, it was not until Mason et al. (1986) reported it as *I. cardiophylla* that botanists realized that its range had been extended west from Texas where the type was collected (Austin 1992). The population outside Tombstone was relocated in 1989 (*Austin & Austin 7608*, ASU), but this species has not been collected in Arizona since that date.

This rare species extends north through eastern Mexico and terminates in southeastern Arizona (Fig. 3). *Ipomoea cardiophylla* is part of the Chihuahuan Desert flora, although it tends to be concentrated along the eastern margin.

Ipomoea thurberi A. Gray has been known from Arizona since 1927 (*Peebles 4669*, ARIZ). Austin (1991, 1992, 1998a) studied the plants and mapped the localities then known. Since 1998 the species has been found in the Sonoita Creek State Natural Area (*McLaughlin 8473*, ARIZ) and on the Audubon Research Ranch (*McLaughlin 9794*, ARIZ). The next nearest populations are in southern Sonora and Chihuahua (Fig. 3). The species is unknown in the Chihuahuan desert region and reappears to its south, extending in apparently disjunct localities to Chiapas. Thus, it reaches southern Arizona through the Sonoran Desert.

Until recently *Ipomoea hederacea* Jacquin was thought to be a native of the southeastern United States, and introduced into the southwestern Border States (Austin 1990a-b, Austin et al. 2001). This view seemed to be supported as the species had most commonly been found in cultivation and otherwise disturbed lands and only rarely in wilder areas. At the time, it was thought that the plants had been brought from the east as contaminants of seed for agricultural lands and subsequently escaped into native habitats.

Since moving to Arizona in August 2001, I have been able to study *I. hederacea* more extensively in the Santa Cruz Valley and Altar Valley along the border in the south-central part of Arizona. In addition, I have studied the species in Sonora (Austin et al. in prep.). Within Sonora, the more tropical *I. nil* (L.) Roth is replaced in the northern regions by *I. hederacea*. From northern Sonora into Arizona, *I. nil* has not been documented and *I. hederacea* is the only member of this look-alike pair that has been found. I have also examined vouchers of *I. hederacea* from Chihuahua and Tamaulipas, and it has been is reported from Nuevo León. Although I have seen specimens of *I. hederacea* at MEXU from farther south in Guanajuato, Edo. México, Oaxaca, and Chiapas, they are from higher, cooler localities within the tropics.

Plants are abundant in wild areas, often intermixed with native family members. Instead of *I. hederacea* having been introduced into the southwestern United States from an endemic region of origin in the southeastern United States, as I had formerly though, I am now convinced that the native range of *I. hederacea* extends across northern Mexico into the United States and hence into the eastern states. It is only the extreme aridity of the southwestern border region that excluded the species from California and Baja California Norte.

Ipomoea hederacea is closely related to *I. nil*, although neither morphological nor molecular genetic analysis of the pair suggested that they are sister species (Austin et al. 2001, Miller et al. 2004). While these two studies examined different suites of species, it is clear that *I. hederacea* and *I. nil* are related, but probably more closely allied to others in the section *Pharbitis* than to each other.

Several vouchers of *Ipomoea ×leucantha* Jacquin were recorded earlier from Arizona (Austin 1991, 1998a). Prior to publication of those papers, the specimens were mostly considered to be *I. triloba* L. To date, no specimens of *I. triloba* have been examined from Arizona. The species is, however, frequent in Sonora, and it ranges through Chihuahua, Coahuila, Nuevo León, and Tamaulipas south into Mesoamerica and the Caribbean.

Ipomoea triloba may yet appear in Arizona. Because it has been confused with *I. ×leucantha*, the shape of the sepals of both species are illustrated (Fig. 12) as this is by far the easiest way to separate these two taxa. The sepals of *I. triloba* are 6-7 mm. long and the outer pair is oblong to narrowly elliptic-oblong and abruptly obtuse apically. In *I. ×leucantha* the sepals are (8-) 10-14 mm long, and the outer pair is lanceolate-acuminate. *Ipomoea ×leucantha* has glabrous sepals while those of *I. triloba* are at least ciliate, if not more pubescent.

JACQUEMONTIA. *Jacquemontia agrestis* (Choisy) Meisner was found several times in the Baboquivari Mountains of Arizona from the 1920s to the 1940s (Fig. 4). The species was last collected there in 1945 (*Goodding 273-45*, ARIZ), and subsequently has not been found in the state. The continued existence of the species in Arizona was considered unlikely (Austin 1992, 1998a), a judgment made because farther south the species is often a weed in cultivated fields and is rare in habitats not influenced by humans.

Subsequently, the herb was found in Las Guijas Mountains across the Altar Valley east of the Baboquivari Mountains (Pima Co., *Austin s.n.*, 9 Sep. 2002, ARIZ). During an ecological survey of plant communities on the Buenos Aires National Wildlife Refuge, a single *J. agrestis* plant was found in a dense desert scrub community dominated be ocotillo (*Fouquieria splendens* Engelmann) on the northwestern slopes of Las Guijas Mountains (NAD 83, UTM zone 12, 0462365 E, 3053829 N).

Apparently, these small annuals germinate, flower, and fruit in a short period during the fall monsoon season and soon disappear from the landscape. That brief appearance and the comparative rarity of the species surely accounts for its being found infrequently in Arizona.

It is not clear if this is another example of a relict species or if the disjunct range results from human introduction. Further exploration is needed to resolve the reasons for this pattern of distribution.

Since neither a key to the two Arizona species nor a description of *J. agrestis* was given earlier, they are provided here along with illustrations (Fig. 14).

1. Perennials from woody base, stellate pubescent; leaves cordate to truncate basally, to 4.8 cm. wide, apically acute to obtuse; infloreseences loose of 1-7 flowers; sepals ovate to broadly ovate, the outer 2 acute; corollas white, 14-27 mm. long . . . . . ***J. pringlei***

1' Annuals from herbaceous base, glandular and/or stellate pubescent; leaves cordate to subtruncate basally, 0.5-3.5 cm. wide, apically acute to acuminate, rarely obtuse; inflorescences of tight clusters of (1)2-6 flowers; sepals narrowly ovate to lanceolate, attenuate; corollas blue, 6-12 mm. long . . . . . ***J. agrestis***

Jacquemontia agrestis (Choisy) Meisner (L. adj. of the field). Midnight-blue cluster-vine. VINES with stems with glandular and/or stellate trichomes, annual (rarely perennial farther south in range). LEAVES lanceolate to broadly or narrowly ovate, 1-6 cm. long, 0.5-3.5 cm. wide, basally cordate to subtruncate, apically acute to acuminate or rarely obtuse. INFLORESCENCES monochasial. FLOWERS (1-)2-6; on peduncles 1-8 cm long, the pedicels 3-15 mm long, erect in fruit; bracts linear, inconspicuous; sepals subequal or the inner shorter, ovate, narrowly ovate or lanceolate, 3.5-6.5 mm. long, with long attenuate apices, with only stellate trichomes or stellate and glandular indumentum; corollas subrotate to campanulate, 6-12 mm long, blue, glabrous; stamens unequal, 3.5-7 mm long, included; anthers 1 mm long; ovary subglobose, 1 mm long, 2-locular, glabrous; styles 3-5.5 mm long. FRUITS capsular, subglobose, 4-5 mm. wide; seeds 1-4, 2-3 mm long, trigonous, semicircular in longitudinal section, minutely areolate and strongly verrucose, minutely winged on the outer 2 margins. [*Convolvulus agrestis* Choisy in De Candolle; *Jacquemontia palmeri* S. Watson]. -- Cultivated fields, disturbed margins, desertscrub; Pima Co.; 1100-1200 m. (3500-4000 ft.); Sep-Mar; Baja C., Son., Sin., Dgo., Nay., Jal., Ver., s to Arg.; also in Cuba.

The species is easily identified when glandular trichomes are present. When lacking glandular trichomes, it still can be distinguished from the other species in nearby Sonora by its clustered few-flowered cymes and lanceolate sepals.

Jacquemontia pringlei A. Gray is mostly found in the mountains of eastern Pima County and surrounding areas (Rincon, Santa Catalina, Tanque Verde Mountains). There are, however, a few outlying localities known, e.g. an 1895 collection from the Chiricahua Mountains (*Toumey s.n.*, NY, UC). The species is disjunct to the west in the Ajo Mountains where it has been collected three times.

The Ajo Mountain locality is odd enough in this arid region, but *J. pringlei* was also collected in the south end of the "Gila Mountains" on 25 April 1938 (*Nichol s.n.*, ARIZ). Felger (pers. comm., Jan. 2006) has been in both the Tinajas Altas Mountains, which are south of the Gila Mountains, and in the Gila Mountains and not found the species.

Felger (Felger et al., in prep.) writes: "Before the mid-20th century it was customary to include the Tinajas Altas Mountains in the concept of the Gila Mountains. But I think it is more likely he [Nichol] was somewhere in the Gila Mountains and not in Tinajas Altas. On that same day he collected *Muhlenbergia*

dumosa in the "Mohawk Mountains" and *Aristida purpurea* in the "Gila Mountains" (specimens at ARIZ). In late 2005 I went to Spook Canyon in the southern part of the Gila Mountains, and there is a side canyon that seems like it could have once supported a plant such as *Jacquemontia*, yet the locality does seem unusual. Although the Gila Mountains are extremely arid, there are quite a few water holes."

Robertson (1971) considered *J. pringlei* endemic to the Sonoran Desert, the former reports of it extending to the south as far as Oaxaca having been based on misidentified specimens. There is a specimen from Chihuahua, collected in Batopilas (Fig. 1) by Palmer (*107*, GH, NY) that he gathered in 1895, and Robertson agrees that it is this species. *Jacquemontia pringlei*, therefore, is a near-endemic to the Sonoran Desert as the Batopilas region is part of the Sierra Madrean woodlands. Robertson was apparently unable to establish the locality of this collection as it is not included in his distribution map.

Even in Sonora, *J. pringlei* is not endemic to the Sonoran Desert. The species also grows in tropical deciduous forest near Tepoca in the Municipios de Yécora, Onavas, and Soyopa (*Reina-G. 97-1082, 98-1055, 98-1410, 2000-464*; *Trauba 572-98*; *Van Devender 98-1175, 2005-390*, all ARIZ), foothills thornscrub near Tónichi, Municipio de Soyopa (*Van Devender 2000-666*, ARIZ), and desert grassland (10.3 km NE of Imuris: *Van Devender 2000-693*, ARIZ).

ACKNOWLEDGMENTS

Marc Baker drew my attention to *Convolvulus simulans* in Arizona and kindly provided his photographs. Tom Van Devender pointed out the northern extension of *Ipomoea aristolochiifolia*. Specimens from A, ASC, ASU, ARIZ, CAS, DES, GH, MEXU, NMC, NY, UC, UNM, and US were studied, and I thank the curators of those institutions. Photographs were scanned at the Arizona-Sonora Desert Museum, courtesy of Mark A. Dimmitt and Sloane Heywood. Benjamin Krein helped with technical problems. Ildiko Palyka kindly helped with the color plates. Kenneth R. Robertson and Tomas R. Van Devender reviewed an early draft of the manuscript.

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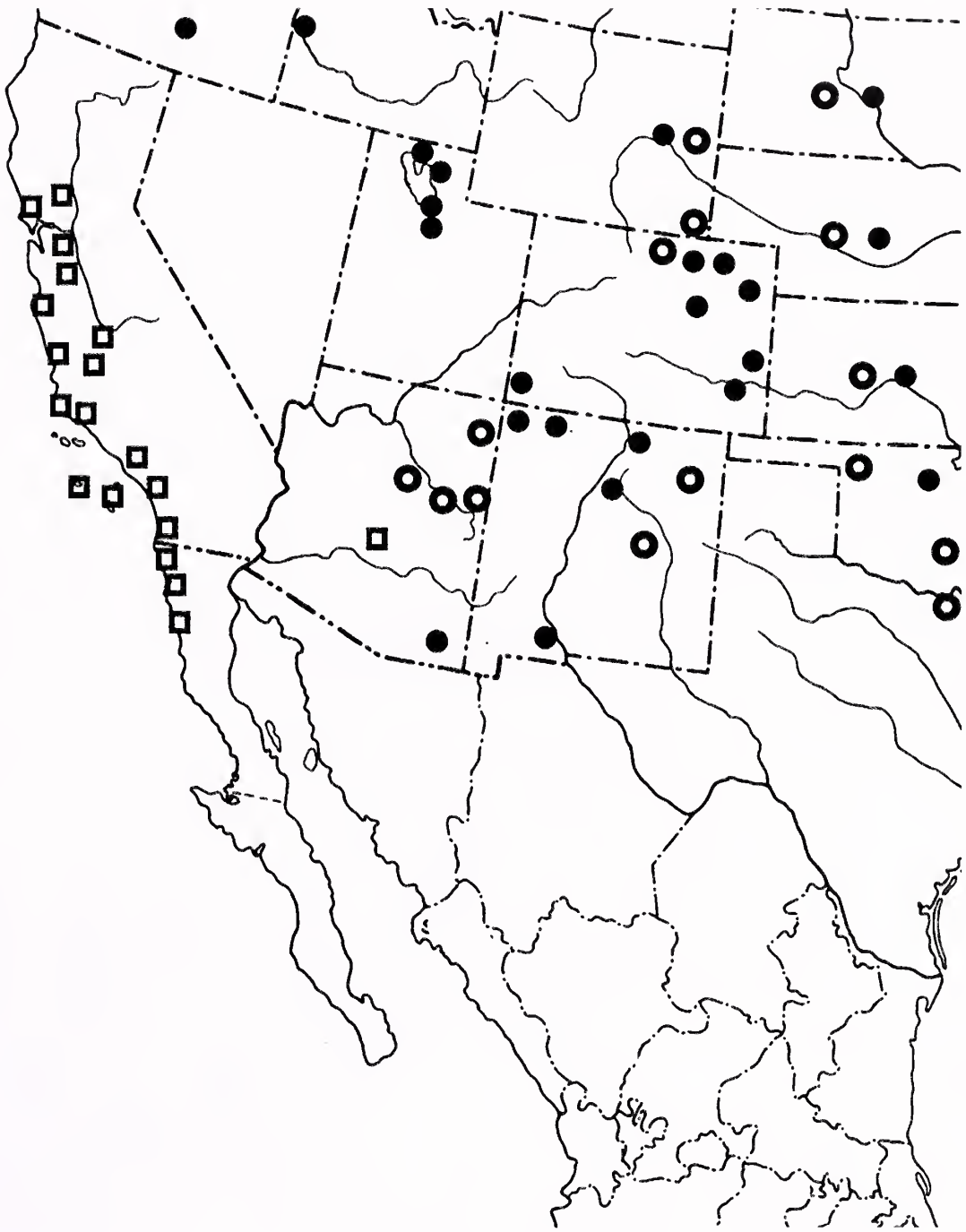
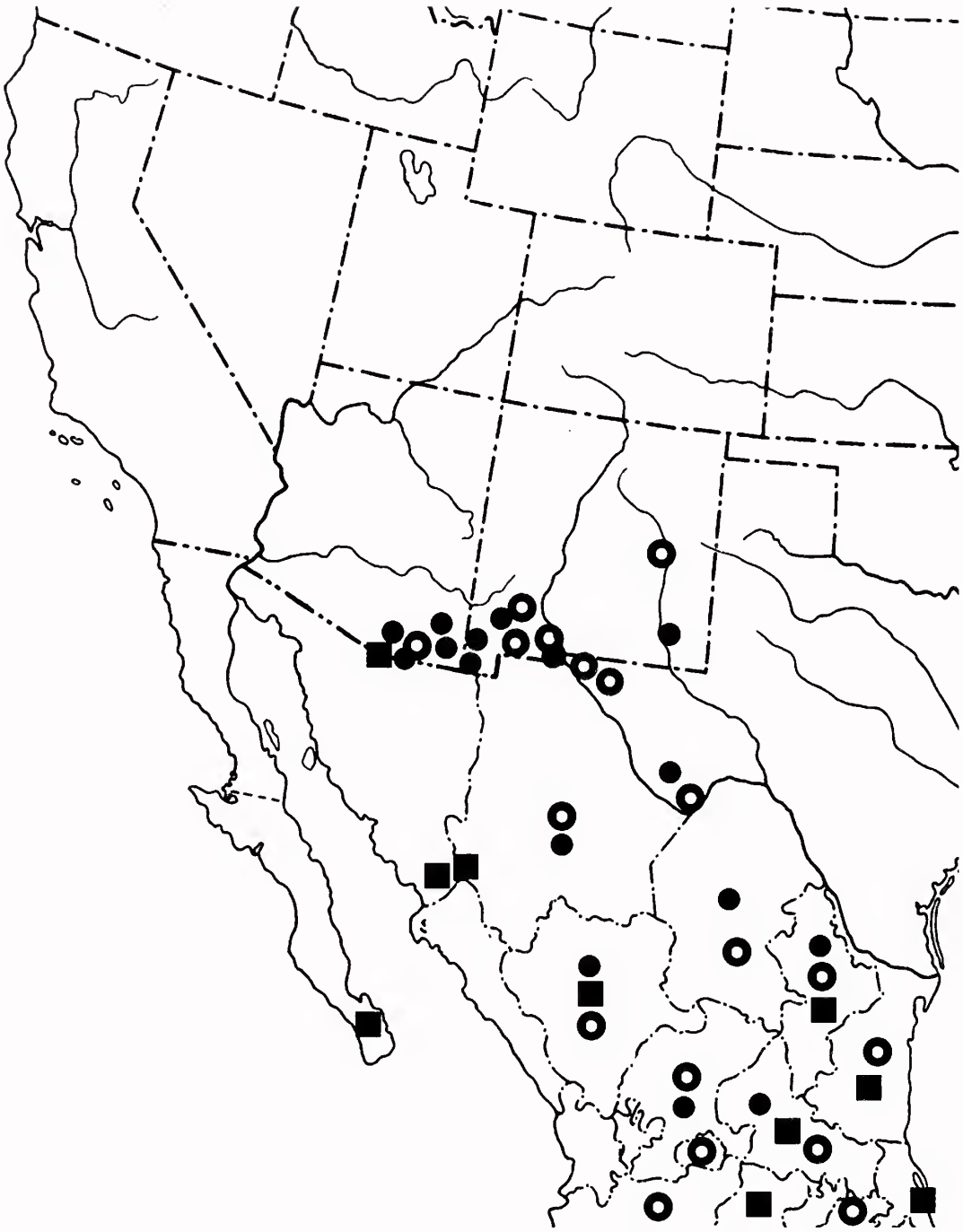
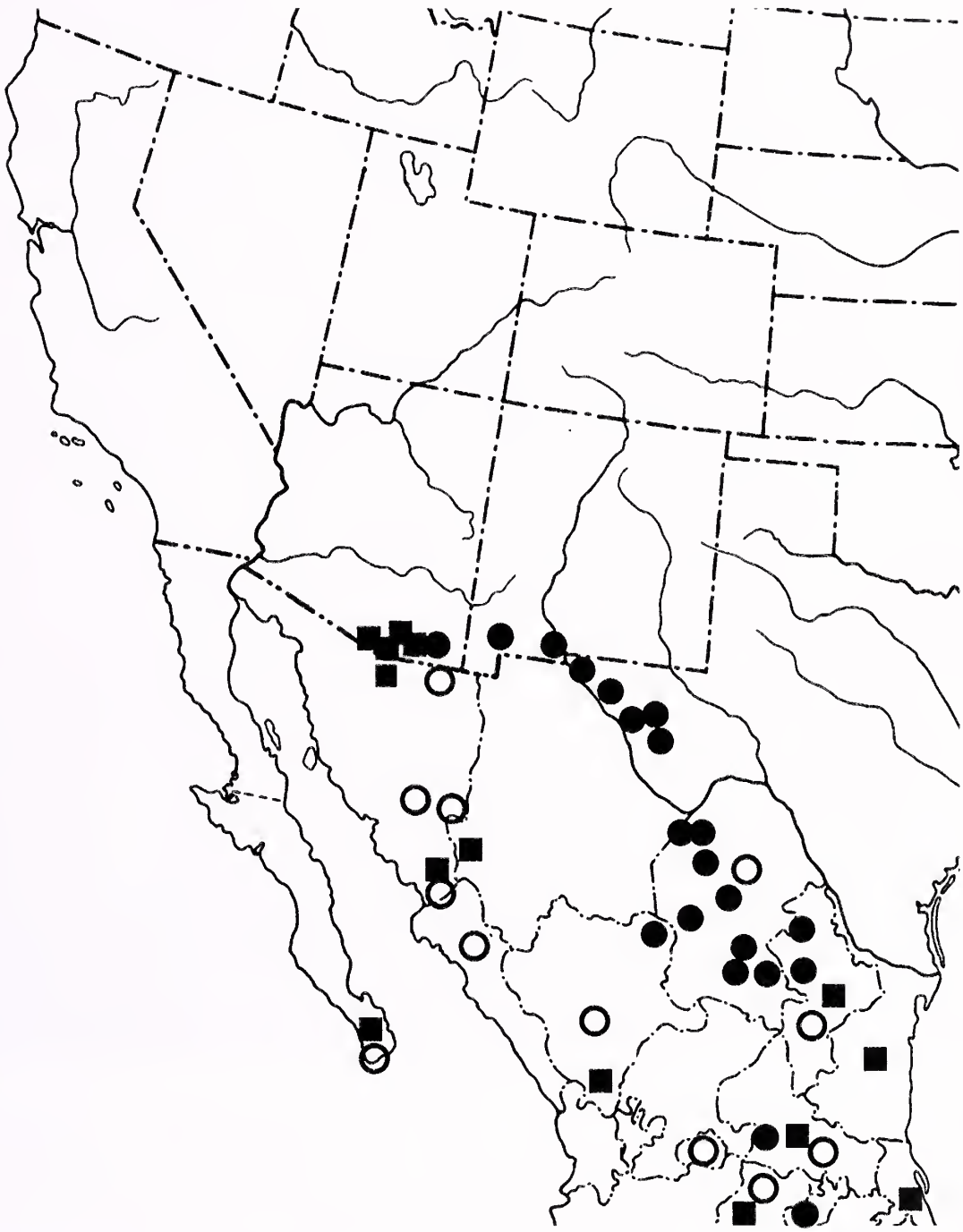


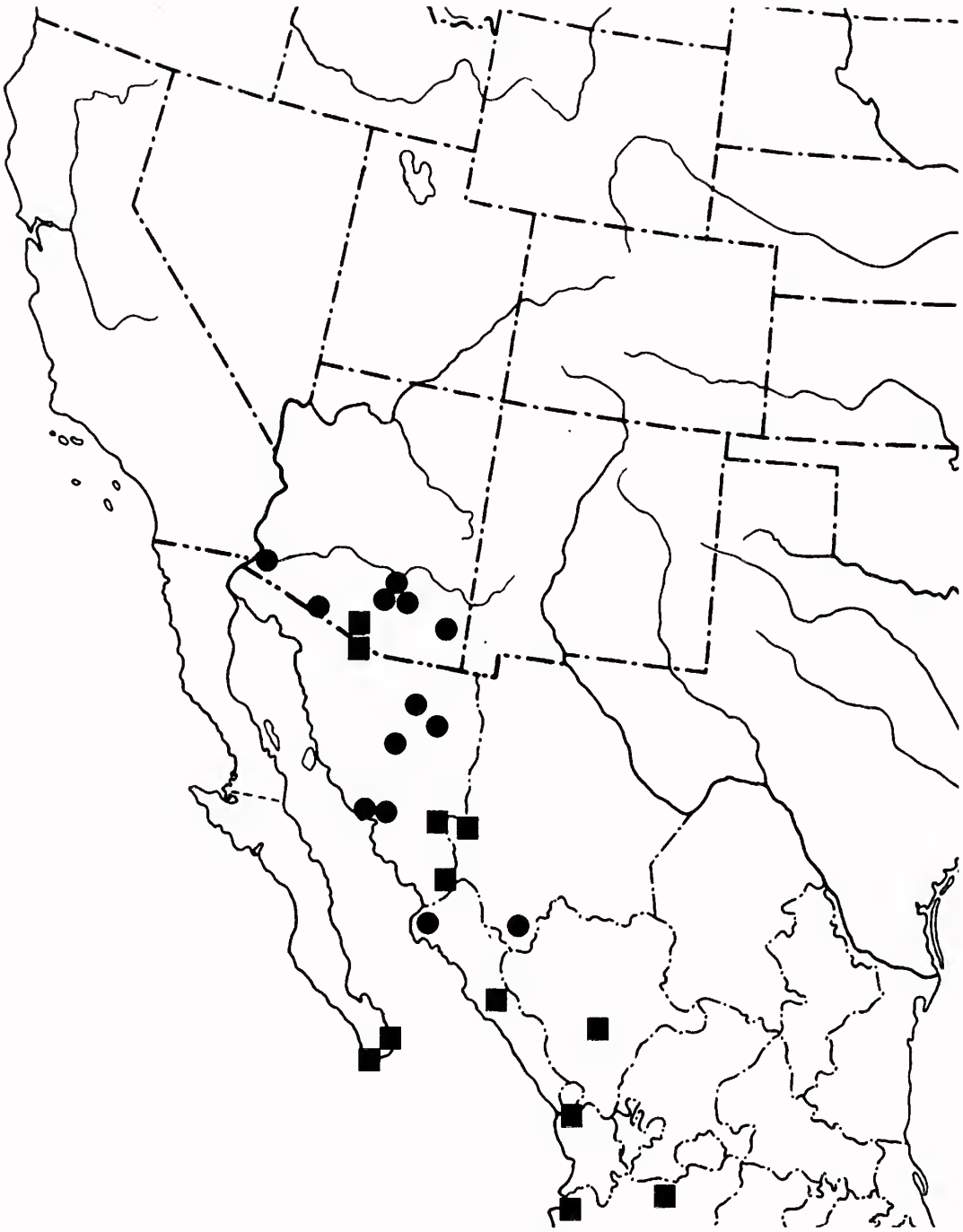
Convolvulaceae Figure 1. Southwestern distribution of *Calystegia* and *Convolvulus simulans*: *Calystegia macounii* (open circles); *Calystegia sepium* ssp. *angulata* (solid circles); *Convolvulus simulans* (open squares).



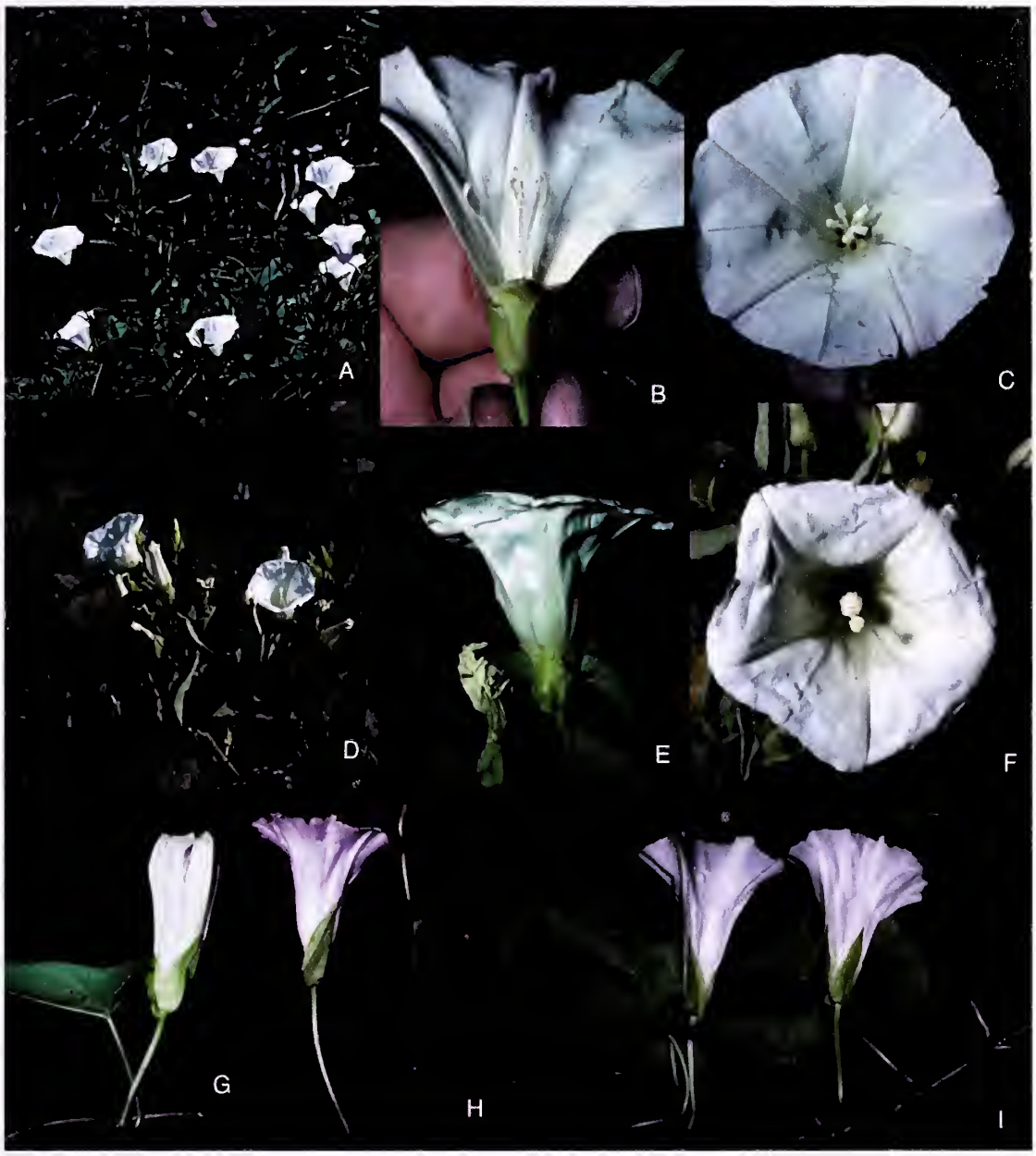
Convolvulaceae Figure 2. Southwestern distribution of *Dichondra*: *Dichondra argentea* (open circles); *Dichondra brachypoda* (solid circles); *Dichondra sericea* (solid squares).



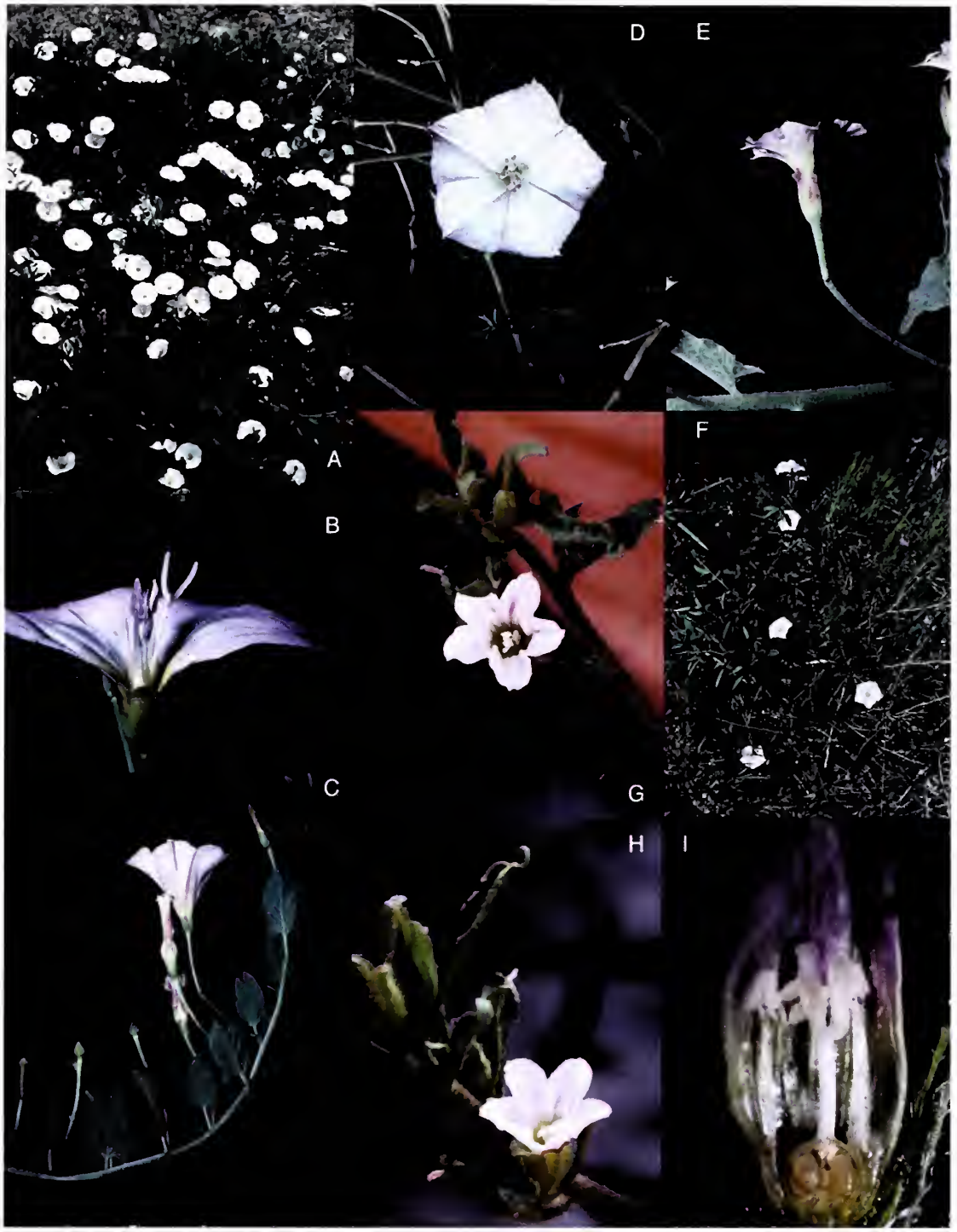
Convolvulaceae Figure 3. Southwestern distribution of *Ipomoea*: *Ipomoea cardiophylla* (open circles); *Ipomoea thurberi* (solid squares); *Ipomoea aristolochiifolia* (solid circles).



Convolvulaceae Figure 4. Southwestern distribution of *Jacquemontia*: *Jacquemontia agrestis* (solid squares); *Jacquemontia pringlei* (solid circles).



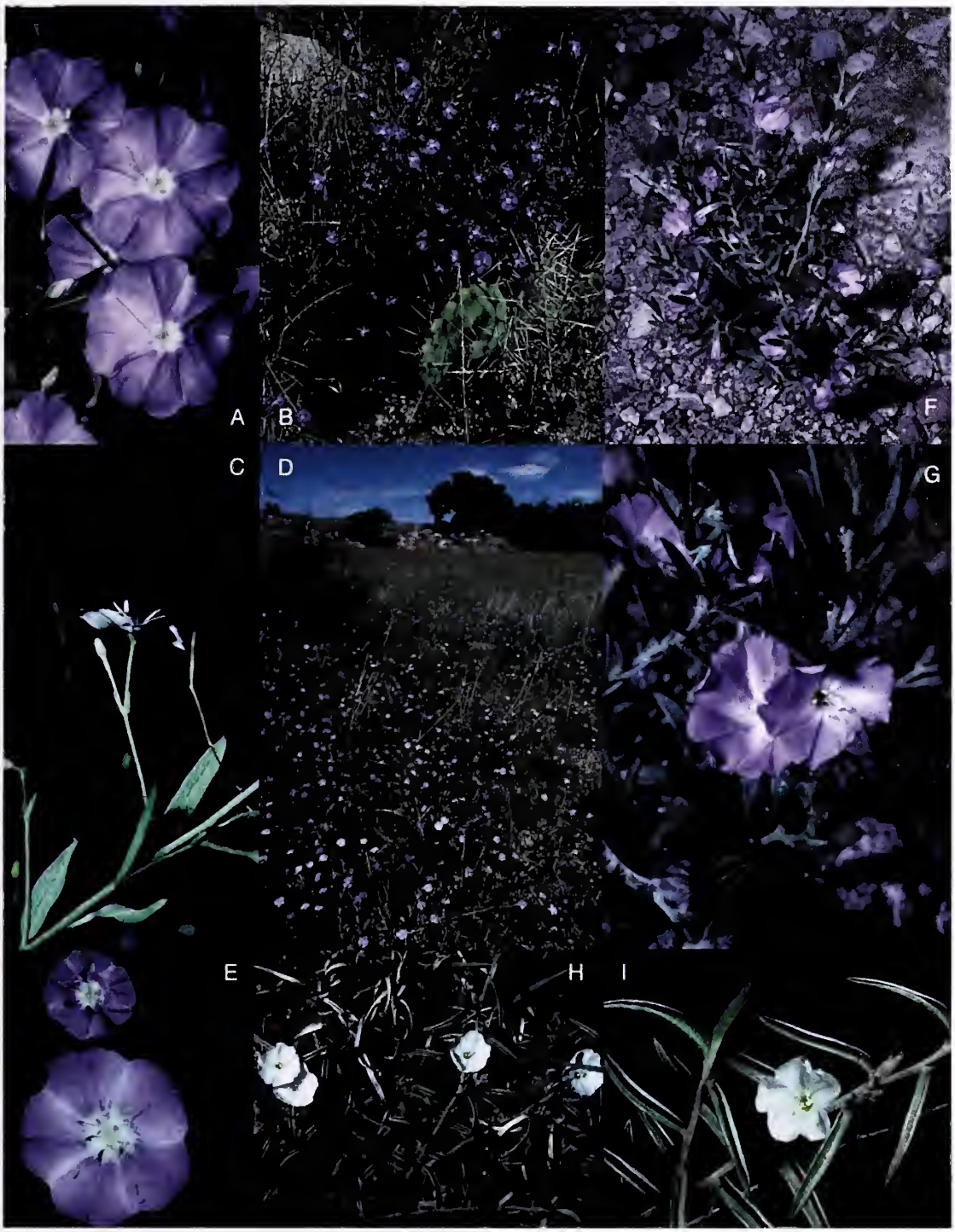
Convolvulaceae Figure 5. *Calystegia*. **A-C,** *C. longipes*: (A) Habit; (B) Flower in cross-section; (C) Flower top view. **D-F,** *C. macounii*: (D) Habit; (E) Flower side view; (F) Flower top view. **G-I,** *C. sepium*: (G) Bud just before opening; (H) Flower with leaf; (I) Branch with flowers and leaves. (A-C, Sierra Ancha Mts., AZ; D-F, south of Flagstaff, AZ; G, near Mount Vernon, IL; H-I, Taos, Taos Co., NM).



Convolvulaceae Figure 6. *Convolvulus*. **A-C,** *C. arvensis*: (A) Habit; (B) Side view of flower, dissected; (C) Branch with flowers and leaves. **D-F,** *C. equitans*: (D) Flower, top view; (E) Flower, side view with leaves; (F) Habit. **G-I,** *C. simulans*: (G) Flower, top view; (H) Flower, side view; (I) Flower dissected longitudinally. (A, Cortez, Montezuma Co., CO; B-C, Zuni, McKinley Co., NM; D, Taos, Taos Co., NM; E, TX; F, Chiricahua Mts., Cochise Co., AZ; G-I, Gila Co., AZ).

Convolvulaceae Figure 7. *Cressa.* **A-D,** *C. truxillensis*: (A) Habitat; (B) Growth form with stolons; (C) Root system on individual plant; (D) Flowering and fruiting plants. (A-D, Baja California, Mexico; photos by Richard S. Felger).

Convolvulaceae Figure 8. *Dichondra.* **A-D,** *D. brachypoda*: (A) Habit; (B) Flower, enlarged; (C) Flowering branch; (D) Fruit, enlarged. **E-F,** *D. sericea*: (E) Part of plant showing contrasting colors of upper and lower leaf surfaces; (F) Flower, enlarged. **G-H,** *D. micrantha*: (G) Habit; (H) Flower, enlarged - note purple anthers. (A-D, Chiricahuas Mts., Cochise Co., AZ; E-F, Pajarito Mts., Santa Cruz Co., AZ; G-H, Boca Raton, FL).



Convolvulaceae Figure 9. *Evolvulus*. **A-E,** *E. arizonicus*. (A) Flowers; (B) Habit; (C) Branch with flower and buds; (D) Habitat; (E) Comparison of flower size in *E. alsinoides* (top) and *E. arizonicus* (bottom). **F-G,** *E. nuttallianus*: (F) Habit; (G) Flowers. **H-I,** *E. sericeus*: (H) Habit; (I) Flowering branch. (A, Sonoita, Santa Cruz Co., AZ; B & D-E, Santa Catalina Mts., Pima Co., AZ; C, Patagonia, Santa Cruz Co., AZ; F-G, Huachuca Mts., Cochise Co., AZ; H-I, Chiricahua Mts., Cochise Co., AZ).

Convolvulaceae Figure 10. *Ipomoea.* **A-D,** *I. barbatisepala*: (A) Flowering plant; (B) Branch with flower and leaf; (C) Flower, top view; (D) Flower, side view. **E-G,** *I. cardiophylla:* (E) Flower, side view; (F) Comparison with *I. hederacea* (left), side view; (G) Comparison with *I. hederacea* (left), top view; **H-J,** *I. capillacea;* (H) Flower, side view; (I) Flower, top view; (J) Habit. (A-D, Santa Catalina Mts., Pima Co., AZ; E-G, near Tombstone, Cochise Co., AZ; H-J, Huachuca Mts., Cochise Co., AZ).

Convolvulaceae Figure 11. *Ipomoea*. **A-B,** *I. costellata*: (A) Flower, side view; (B) Flower, top view. **C-E,** *I. hederacea*: (C) Flower, side view; (D) Flower, top view; (E) Fruit. **F-H,** *I. cristulata*: (F) Flower, top view; (G) Flower, side view; (H) Habit. **I-K,** *I. leptophylla*: (I) Flower, side view; (J) Flowers, top view; (K) Habit. (A-B, Mule Mts., Cochise Co., AZ; C-H, Santa Catalina Mts., Pima Co., AZ; I-K, KS).

Convolvulaceae Figure 12. *Ipomoea.* **A-B,** *I.* ×*leucantha*: (A) Flower, top view; (B) Flower, side view of sepals and corolla base. **C-D,** Flowers of *I. triloba* for comparison with *I.* ×*leucantha.* **E-F,** Flowers of *I. longifolia.* **G-H,** *I. plummerae*: (G) Flower, top view; (H) Flowering branch, with side view of flower. **I-K,** *I. pubescens*: (I) Nocturnal flower, side view; (J) Partly closed flower, side view, (K) Nocturnal flower, top view. (A, Sumter Co., FL; B, Boca Raton, FL; C-D, Grand Bahama, Bahama Islands; E-F, Patagonia Mountains, Santa Cruz Co., AZ; G-H, Chiricahua Mountains, Cochise Co., AZ; I & K, Baboquivari Mountains, Pima Co., AZ; J, Pajarito Mountains, Santa Cruz Co., AZ).

Convolvulaceae Figure 13. *Ipomoea*. **A-C,** *I. purpurea*: (A) Variation in flower sizes from one plant, side view; (B) Variation in flower sizes from one plant, top view; (C) Fruiting branch. **D-F,** *I. ternifolia* var. *leptotoma*: (D) Flower, side view; (E) Flower, top view; (F) Habit. **G-H,** *I. tenuiloba*: (G) Nocturnal flower, side view; (H) Nocturnal flower, top view. **I-K,** *I. thurberi*: (I) Nocturnal flowers and habit; (J) Nocturnal flower, top view; (K) Nocturnal flower, side view. (A-C, Huachuca Mountains, Cochise Co., AZ; D-H, Santa Catalina Mountains, Pima Co., AZ; I-K, Pajarito Mountains, Santa Cruz Co., AZ).

Convolvulaceae Figure 14. *Jacquemontia*. **A-B,** *J. agrestis*: (A) Top view of flower; (B) Inflorescences with flowers, buds, and young fruit. **C-E,** *J. pringlei*: (C) Habit; (D) Flowers, side view; (E) Flowers, top view. (A-B, Veracruz, Mexico; C-E, Santa Catalina Mountains, Pima Co., AZ).